RUNNING HEAD: Language of Dementia

The Qualitative Differences in Analyzing Language Data of People with Dementia Using the SALT versus CLAN Programs

Research Thesis

Presented in partial fulfillment of the requirements for graduation *with research distinction* in Speech and Hearing Science in the undergraduate colleges of The Ohio State University

By

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June 2012

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Acknowledgements

I would like to think Davida Fromm at Carnegie Mellon for her continuous help throughout this process. I would also like to thank the College of Arts and Sciences as well as College of Social and Behavioral Sciences for bestowing scholarship money to me for my research. Lastly, I want to thank my advisor, Michelle Bourgeois for being my mentor throughout my undergraduate career.

Abstract

Therapists need efficient and accurate ways to document language problems in order to design effective interventions. Computer software is available to support the analysis of language data. The purpose of this study is to compare the types of data generated by two software programs, SALT and CLAN, in order to make recommendations about which program will best support clinicians' assessments of language samples.

The Qualitative Differences in Analyzing Language Data of People with Dementia Using the SALT versus CLAN Programs.

Changes in language, behavior, and cognition cause limitations for people with dementia to communicate (Bourgeois & Hickey, 2009). Simple actions that people take for granted such as engaging with others in a social environment can be quite challenging for people with dementia. This is because their language problems are due to the cognitive deficits associated with dementia (Bourgeois and Hickey, 2009). It is important to understand these language problems and to design treatment programs to help compensate for them.

When studying language, its important to look at the words and grammar the patient uses. In the early stages of dementia, there are mild expressive language deficits related to word finding problems for names of people and places (Almor et al., 2009). However, during this stage, syntax and pragmatics are intact. As the patient progresses to the middle stage of dementia, there is an increase in word-finding problems, difficulty with conversation, and maintaining topic organization. In later stages of dementia, problems with semantics interfere extensively to a point when only single words or short phrases are spoken. During this period, syntax in the patient's speech worsens in terms of the length of sentences, the complexity of the grammar, verbal fluency, and the content (Bourgeois & Hickey, 2009). Patients with dementia may also use nonspecific or general vocabulary. For example, a person may say "animal" instead of "cat". Cross-category errors may also occur where a patient may say "pear" for "cat". Over time, some patients with dementia may lose access to semantic concepts, and may just answer, "I don't know" (Almor et al., 2009).

Memory is just as crucial as the language used. The first signs of cognitive decline in patients with dementia involve memory problems. Baddeley's (1995) model of working memory proposes three main processing components that can be affected. These include encoding or registering information, storing this information, and retrieving it later on. The process starts when information enters a person's neurological system using the five senses (i.e., hearing, vision, touch, taste, and smell), and then becomes encoded as sensory memory. When encoding doesn't occur it can be due to age-related problems like a loss in vision or hearing. These issues can make it complicated to recognize sensory information. Sensory information is then held temporarily, and is processed in working memory, or short-term memory where this information is used to respond. If the message information is important, the person uses it right away. However, if the information is needed at a later time, it is stored into long-term memory for retrieval later (Bourgeois & Hickey, 2009). Working memory is a difficult process for an individual with dementia because in a conversation they need to remember what they want to say while also processing ongoing speech from their partner (Almor et al., 1999). Long-term memory has been described as declarative, explicit (controlled) or implicit (procedural) memory (Bourgeois & Hickey, 2009). If declarative or semantic memory has been stored for many years, it may become somewhat resistant to the progression of dementia. The ability to gain access to this information, however, declines remarkably. The earliest difficulty for patients with dementia is the failure to retrieve words from long-term storage, or anomia. Some people may also experience trouble in conversations when trying to remember a familiar person's name. These word-finding problems interfere with conversation (Bourgeois & Hickey, 2009). The individual's speech is often described as "empty" as it contains a high proportion of words and utterances that convey little or no information. For example, instead of naming a specific location, they would say, "over there" or "that one" to refer to a person. The most obvious characteristic of empty speech is the overuse of "empty words" (Almor et al., 1999). Episodic memory can be vulnerable to the progression of dementia as well because various forms of information need to be encoded simultaneously when experiencing an event (Bourgeois & Hickey, 2009). For example, to remember a specific event, it is necessary to encode detailed information about the place, time, action, and persons involved in the episode.

Memory problems are apparent in the language of patients with dementia. Clinicians can determine these problems via language samples. Once they have a language sample they want to study, they go through a transcription process where they transfer what is recorded on the audiotape (or videotape) to written form. Clinicians then have another person listen to the audiotape and check the accuracy of the transcription, correcting any disagreements or errors in transcription. They can analyze the transcript for the quantity and quality of the patient's language. Some examples of quantity include the length of sample or the number of words or pauses. Quality of the sample would include the types of language forms such as nouns, verbs, adjectives, and adverbs as well as the grammatical forms like morphemes and word endings. Some of these word endings include a plural "s" or a verb tense ending such as "ed" or "ing". Analyzing transcripts manually is very time consuming. However, there are computer programs that analyze these language samples and are time efficient. The CLAN program, or Computerized Language ANalysis, is a tool for transcription, coding, and analysis (MacWhinney, 2007). SALT, or Systematic Analysis of Language Transcription, is the second common program used for language analysis for a variety of language impairments of children and adults. SALT documents the existence of problems with utterance formulation, word finding, semantic or reference deficits, delayed development, and pragmatics (Miller & Iglesias, 2010).

The CLAN and SALT programs were developed independently, but they overlap somewhat in their transcription, analysis, and interpretation of language problems. Historically, clinicians recorded language samples, transcribed them by hand, and then manually counted the frequency of each type of language feature in the sample. This process was time consuming and required training sessions to establish reliability of coding the transcripts. The use of computer programs to do the analysis has the potential to decrease time needed for the analysis and increase efficiency and the accuracy of coding.

In the fall of 1981, Jon Miller and Robin Chapman developed the first experiment to determine whether a computer could analyze language samples. SALT software was the result of this experiment, and it was designed to overcome issues associated with written transcription and analysis like time and consistency. In order to do this, Miller and his colleagues reduced time requirements by standardizing the formats for transcription, and used computers to calculate many measures without excessive coding. Clinicians were able to do so by using a controller box to alter the speed of either audio or video playback and dually typing and coding in the template window (Evans & Miller, 1999). The first couple of standard assessment measures SALT used were the mean length of utterance (MLU) and type-token ratios (TTR), (Evans & Miller, 1999). The MLU calculates the ratio of morphemes to utterances in the person’s speech, and the TTR calculates the number of different words used divided by the total number of words. As the use of SALT expanded, other variables were analyzed, such as the percent of unintelligible utterances, repetitions, and omission of words (Evans & Miller, 1999). These improvements in transcription helped clinicians calculate these variables within a matter of seconds, characterize a disorder more efficiently, and improve the reliability of the transcript.

In the summer of 1981, a group consisting of Dan Slobin, Willem Levelt, Susan Ervin-Tripp, and Brian MacWhinney developed an idea to create an international archive for researchers who were interested in analyzing language from children of different ages and varied languages. In 1984, Brian MacWhinney and Catherine Snow received a grant to create the Child Language Data Exchange System (CHILDES). The purpose of the CHILDES database was to collect language samples from a variety of speakers and to study analysis the transcripts in a more efficient manner by providing coding schemes for any part of language that might be of interest to a clinician (Evans & Miller, 1999). Today, the CHILDES database gives access to different transcripts linked to audio or video files that document demographic variables such as, ethnicity, age, aphasia, traumatic brain injury, dementia, and also different languages (Evan & Miller, 1999). This system consists of three separate but intertwining tools. These tools are the Codes for Human Analysis of Transcripts (CHAT) transcription coding, Child Language ANalysis (CLAN), and the CHILDES database. These tools work together because the transcripts in the CHILDES database are put into CHAT format where they are transcribed using coding. CLAN is able to analyze different language variables from these coded transcripts (Evan & Miller. 1999). Like SALT, you are presented with a transcript window, and a visual or audio display of the interview. Consequently, the clinician can highlight a portion of the transcript or use simple keyboard commands, and that section will automatically be played back through audio or video window controller, thus eliminating the need for playback machines. Once the clinician feels confident that the transcription process is complete, a button allows the audio or video to link to the transcript and plays one utterance after another. CHAT's playback method helps provide reliability for the transcript (Evans & Miller, 1999).

There are some similarities between SALT and CLAN in the way they can separate the participant from the interviewer in the transcript, and they both are able to calculate similar variables (Evans & Miller, 1999). Also, CHAT transcripts can be converted automatically into SALT. When both programs are used, it can help the clinician gain an overall profile of the patient (Evans & Miller, 1999).

Since both programs were created independently, there are differences between the two as well. Although SALT and CLAN are able to calculate the similar variables, they both calculate separate variables as well. For example, CLAN is able to identify the biggest word or utterance in a transcript by using the MAXWD command. This command will also show the line where the word or utterance is located in the transcript, its total length, and the name of the file. SALT also has its own unique variable that calculates the number of omitted words and bound morphemes in a language sample, singling out words that were started and left unfinished (MacWhinney, 2000). Table 1 displays all the differences in variables between CLAN and SALT.

Table 1

Difference in Variables between CLAN and SALT

Command/ Language Measurement	
(Different features; Same features)	
CLAN	**SALT**
Syntax/Morphology	
MLU in words	MLU in words
MLU in morphemes	MLU in morphemes
Semantics	
FREQ: Computes the frequencies of the words in a file or files	Type-Token Ratio
FREQMERG: Combines the outputs of	
Various runs in FREQ.	
FREQPOS: Tracks the frequencies in	
various utterance positions.	
GEMFREQ: Computes frequencies for	
words inside GEM markers.	
Discourse	
MLT: Mean Length of Turn in words.	MLT: Mean Length of Turn
	-%Responses to Questions
	-Utterances with Overlaps
Transcript Length	
WDLEN: Computes the length of utterances	- Analysis Set Utterances
Intelligibility	
	- % of complete verbal
	- Complete Utterances
Verbal Facility and Rate	
TIMEDUR: computes the duration of the pauses Words/Minute	
Other	
CHAINS: Tracks sequences of interactional codes	- Omitted Morphemes
CHECK: Verifies the correct use of CHAT format.	- Word-level Error Codes
RELY: Measures reliability across two transcriptions.	
KWAL: Searches for word patterns and prints the line.	
MAXWD: Finds the longest words in a file.	

Some other differences between the two are how certain commands used in CLAN do not convert into SALT. If the transcript is complete with no errors, it is possible to use SALT to check its standard measures output for reliability, but special commands used in CLAN are not recognized. For example, CHAT has a %mor code that breaks up morphemes and part of speech, and uses symbols to separate them. MOR generates a %mor tier where it looks at each word, and provides all possible grammatical categories and morphological analyses without regard to its context (MacWhinney, 2000). For example, if a participant said “gonna” instead of “going to”, the %mor line would point this out in the transcript. CLAN uses the +t*PAR command when doing an analysis that excludes the %mor line leaving only the participants actual wording with no morphological analysis (MacWhinney, 2000). Using this in CLAN doesn’t convert into SALT, and this may result in discrepancies in variables between the two programs. Another key difference between SALT and CLAN is that certain codes used in CHAT transcription such as gestures (&=laughs) are seen as errors in SALT, and need to be deleted before further analysis. SALT does, however, allow for looking up the words and morphemes it is using to calculate these certain variables. This requires a manual comparison to find what words or morphemes SALT is keeping versus what CLAN is choosing to exclude. Another difference between the two programs is that CLAN provides the opportunity to put information into a spreadsheet by using commands such as +d2 or +d. This helps when a researcher wants to put data into an Excel spreadsheet. SALT puts its results in its own organized “Standard Measures” output. Finally, CLAN and SALT have primarily been used to analyze children’s speech, but there has not been much research on using them for language analysis patients with dementia.

These programs are useful for analyzing the patient's semantic and syntactic abilities. Both programs calculate the type-token ratio, or the number of different words used divided by the total number of words. This command is used because it is crucial in tracking the semantic problems of patients with dementia. The two programs also examine the syntax in the language of patients with dementia. To study the syntax, the two programs use the MLU command, or the mean length of utterance command. MLU calculates the ratio of morphemes over utterances in the person's speech. Brown states that the MLU command is important because morphemes reflect syntactic growth better then the mean length of utterances in words (as cited in MacWhinney, 2000). The purpose of this study is to find out if SALT and CLAN can provide comparable data for language analysis of patients with dementia, and if programs such as these can help better describe the language of patients with dementia.

Method

Participants

The transcripts and audio files used in this study were obtained from the Alzheimer and Related Dementias Research Center at the University of Pittsburgh School of Medicine. Since 1983, about 511 patients with dementia were administered a battery of diagnostic tests that were audio recorded. A database contains recordings of these patients with various types of dementia. Information about these participants also includes their age, gender, education, and *Mini Mental State Examination* score (MMSE) (Folstein, Folstein & McHugh, 1975).

For this research, patients who had a MMSE score between 17-19 out of 30 at their first visit were identified, and 10 were randomly selected. The descriptive data for these participants is displayed in Table 2. The mean age for all of the 10 patients was 73.9, and the standard deviation was 6.4. Two of these patients were males, and there were 8 females. The average MMSE score was 17.9 with the standard deviation being 0.7.

Table 2
Participant Characteristics

File	Age	Sex	MMS
226-1-166v-0	68	Female	19
310-1-214v-0	69	Female	19
358-1-240v-0	60	Female	18
360-1-000v-0	75	Female	18
530-1v-0	83	Female	17
581-1v-0	75	Female	17
648-1v-0	78	Female	18
657-1v-0	74	Male	17
672-1v-0	78	Male	18
Mean (SD):	73.9(6.4)		17.9(0.7)

Materials and Procedure

Interviewers for larger study at the University of Pittsburgh were trained by licensed Speech-Language Pathologists, and gave all 10 subjects a battery of tests that included word fluency tasks, reading sentences, story recall, and the *Cookie Theft Picture* description task (Goodglass & Kaplan, 1983). The main focus of this study deals with the *Cookie Theft Picture* description task where the patient must describe a black and white drawing with two children stealing cookies out of a cookie jar in a kitchen with other visual stimuli. Adobe Audition software was used to extract only the *Cookie Theft Picture* description from the rest of the battery tests in the audio recording. Next, each file was transcribed using the CHAT coding. A template window opened up with a playback window that allows the audio to play as the conversation between the interviewer and participant was typed out and coded for grammatical and expressive errors. Some examples of these codes used in CHAT transcription are shown in Table 3.

Table 3
CHAT Codes

Code	Meaning
(…)	Long pauses
&	Word fragments and filters
xxx	Unintelligible Speech
+//	Self-Interruption
[: text]	Replacement
[//]	Retracing

The transcripts were then analyzed with the CHECK command in CLAN to make sure the transcripts were error free, and everything was coded correctly. The extracted audio clip and coded transcript were then sent to researchers at Carnegie Mellon University who double checked the transcript for errors, provided feedback if coding was missing or not necessary, and established reliability. Once these files were completely checked, they could be used to study different aspects of the patient's speech. An example of an error-free transcript is shown in Table 4.

Table 4

CHAT error-free coded transcript

```
@Begin
@Languages:     eng
@Participants:  PAR 657-1v-0 Participant, INV Investigator
@ID:    eng|UPMC|PAR|74;|male|ProbableAD|657-1v-0|Participant|17||
@ID:    eng|UPMC|INV||||657-1v-0|Investigator|||
@Media: 657-1v-0, audio
*INV:   picture that has a lot of action going on there's a lot of things
        going on in the picture . ▸
*INV:   tell me what you see going on in the picture . ▸
*PAR:   well she's washin(g) dishes . ▸
*PAR:   he's climbin(g) up to get cookies . ▸
*PAR:   he's gonna [: going to] fall . ▸
*PAR:   and she's laughin(g) . ▸
*INV:   okay . ▸
*PAR:   and she's spill [//] runnin(g) the water over . ▸
*INV:   anything else ? ▸
*PAR:   that looks like someone down out there or somethin(g) . [+ es] ▸
*PAR:   I don't know what that is . [+ exc] ▸
*INV:   okay . ▸
@End
```

To analyze the transcript, the desired commands were selected from a list of CLAN language analysis commands that are displayed in Table 5.

Table 5

CLAN Commands

Syntax/Morphology
○ MLU in Words
○ MLU in Morphemes
Semantics
○ FREQ: Computes the frequencies of the words in a file or files
○ FREQMERG: Combines the outputs of various runs in FREQ
○ FREQPOS: Tracks the frequencies in various utterance position
○ GEMFREQ: Computes frequencies for words inside GEM markers
Discourse
○ MLT: Mean Length of Turn
Transcript Length
○ WDLEN: Computes the length of utterances
Verbal Facility and Rate
○ TIMEDUR: Computes the duration of the pauses (words/minute)
Other
○ CHAINS: Tracks sequences of interactional codes
○ CHECK: Verifies the correct use of CHAT format
○ RELY: Measures reliability across two transcriptions
○ MAXWD: Finds the longest words in a file

The first command used on all 10 transcripts was the FREQ command. This command gives a calculation for the type-token ratio, or the number of different words used divided by the total number of words. The second command used was MLU that calculates the ratio of morphemes over utterances in the person's speech. First, all 10 transcripts were put through CLAN by using an import window where the MLU and TTR were calculated. The commands used in the import window are shown in Table 6.

Table 6
CLAN Input Codes

Command	Input Code
TTR (Type-Token Ratio)	FREQ +t*PAR * *.cha +d [+ exc]
MLU (Mean-Length of Utterance)	MLUm +t*PAR * *.cha +d2 [+ exc]

The +t*PAR was used to single out only the participant's speech, and exclude the %mor line. The asterisks (*) were used to measure all of the audio files in a set. The +d and +d2 were used to put the calculations into a spreadsheet. Lastly, [+ exc] was used to exclude utterances that are not specifically task related, like "I forget" and "Okay" and "Is that enough?

After analysis in CLAN, each transcript was transferred into SALT software by using a feature that allows CHAT files to be imported. By importing these transcripts, a similar looking transcript shows up in a SALT template window. Table 7 shows all of the possible SALT commands.

Table 7
SALT Commands

Syntax/Morphology	
	MLU in Words
	MLU in Morphemes
Semantics	
	Type-Token Ratio
Discourse	
	MLT: Mean Length of Turn
	% Responses to Questions
	Utterances with Overlaps
Transcript Length	
	Analysis Set Utterances
Intelligibility	
	% of complete verbal
	Complete utterances
Other	
	Word-level Error
	Omitted Morphemes

First, certain codes used in CHAT and seen as errors in SALT needed to be erased before further analysis could begin. An example of one of these codes is a gesture (&=laughs). In order to calculate the MLU, bound morphemes were excluded by using the explore option in SALT. Here, the speaker being studied is selected (PAR), total utterances are chosen, and the code =!/= is typed in the edit window. The =!/= code matches all words that do not contain a bound morpheme. Bound morphemes were excluded because the MLU in CLAN only includes basic morphemes. Following this step, the MLU and TTR calculations could be located via the "Standard Measures" output in SALT. The calculations for the 10 CLAN transcripts were displayed in two outputs. The first section is the analysis set which includes utterances that are complete, intelligible, and verbal, and leaves everything else out. The second section uses all of the utterances for calculation despite being unintelligible, interrupted, or gestural (Miller, Andriacchi, & Nockerts, 2001). This is the section that was used to find the TTR and

MLU calculations because there was uncertainty of how much would be left out in the analysis set. It was then possible to compare the MLU and TTR results between CLAN and SALT.

Data Analysis.

The first spreadsheet displayed the number of utterances, types of words, total words, and the ratio of types of words over total words (TTR). The second spreadsheet displayed the number of utterances, morphemes, and the ratio of morphemes over utterances (MLU). The Excel program for Mac calculated the mean for all of these categories as well as correlational analyses to confirm that the two programs calculated specific variables similarly. The Excel program was also used to conduct *T*-tests to determine whether there were significant differences between the calculations for the two programs for the variables of interest.

Results

The data generated from the CLAN and SALT analyses are summarized in Tables 7 and 8. Table 7 shows all of the analysis information for the TTR between the two programs. First, SALT and CLAN have the same mean number of utterances (9.8), but SALT shows a larger mean amount of types of words (49.3 vs 43.3, respectively), and a higher mean TTR (0.72 vs 0.64). There were no differences between CLAN and SALT for total words. All SALT and CLAN TTR variables were highly correlated (#utterances: r=1; Types: r=.88; Total words: r=.95; and TTR: r=.97). *T*-tests examining the differences between CLAN and SALT variables revealed significant differences between the programs for Types (p=0.006) and TTR (p<0.0001). There were no significant differences between programs for Total Words (p = 0.89).

Table 7

Descriptive Data for TTR

File	#Utterances		Types		Total Words		TTR	
	CLAN	SALT	CLAN	SALT	CLAN	SALT	CLAN	SALT
226-1-166v-0	18	18	56	68	116	110	0.483	0.62
310-1-214v-0	13	13	46	46	69	61	0.667	0.75
358-1-240v-0	10	10	40	50	67	76	0.597	0.66
360-1-000v-0	10	10	39	49	63	73	0.619	0.67
530-1v-0	11	11	38	48	65	74	0.585	0.65
581-1v-0	8	8	64	66	131	118	0.489	0.56
648-1v-0	11	11	46	55	63	67	0.73	0.82
657-1v-0	7	7	33	39	39	44	0.846	0.9
672-1v-0	6	6	25	31	38	44	0.658	0.7
714-1v-0	4	4	46	41	59	47	0.78	0.87
Mean	9.8	9.8	43.3	49.3	71	71.4	0.6454	0.72
Correlation (r)	1		0.88451569		0.957717942		0.972597695	
T-Test (p)			0.00682961		0.892873858		<0.0001	

Table 8
Descriptive Data for MLU

File	#Utterances		#Morphemes		MLU	
	CLAN	SALT	CLAN	SALT	CLAN	SALT
226-1-166v-0	18	18	124	139	7.8	7.72
310-1-214v-0	10	13	67	86	6.7	6.6
358-1-240v-0	10	10	78	85	7.8	8.5
360-1-000v-0	10	10	82	75	8.2	7.5
530-1v-0	11	11	75	82	6.8	7.45
581-1v-0	8	8	128	151	16.8	18.875
648-1v-0	11	11	69	77	6.3	7
657-1v-0	7	7	52	45	7.4	6.4
672-1v-0	6	6	51	47	8.5	7.8
714-1v-0	3	4	55	62	18.3	15.5
Mean	9.4	9.8	78.1	84.9	9.46	9.3345
Correlation (r)	0.970003959		0.973116547		0.95381541	
T-Test (p)	0.22286835		0.069116715		0.768392845	

Table 8 displays the analysis information for the MLU between the two programs. The mean number of utterances (9.8 vs. 9.4), and morphemes (84.9 vs. 78.1) were larger in SALT than in CLAN, and CLAN calculated a higher mean MLU then SALT (9.46 vs. 9.33). All SALT and CLAN MLU variables were highly correlated (#utterances: r=.97, morphemes: r=.97, and MLU: r=.95). T-tests revealed no significant differences between the programs (#utterances: p=.22, #morphemes: p=0.06, and MLU: p=0.77).

Discussion

The purpose of this study was to determine if SALT and CLAN provide comparable data for language analysis of patients with dementia, and if this information will help better describe the language of patients with dementia. CLAN and SALT had some similarities and some differences in their data. First, there were no significant differences between the two programs in regards to the number of utterances, number of morphemes, or MLU. There were, however, significant differences between the two programs in terms of the number of types of words and the TTR. These differences may be due to the fact that CLAN excluded unintelligible utterances whereas SALT was including these unintelligible utterances as types of words. The larger difference in types of words between CLAN and SALT resulted in a larger TTR as well. The most noticeable difference occurring between both programs is that codes used in CHAT that are seen as errors in SALT are also counted as types of words in SALT. For instance, the example earlier of the gesture code &=laughs is counted as the word “laughs” in SALT. Also, repetitions or corrections such as “cu” instead of “cup” were counted as types of words. Overall, both of these programs are appropriate for analyzing the language of patients with dementia. However, unlike SALT, CLAN has begun to explore its usefulness beyond only studying children's language, and has expanded its focus on analyzing the language of patients with dementia.

Limitations

Some limitations of this study involve the fact that only 10 transcripts were used for this study, and these samples were from patients with a limited range of MMSE scores (17-19 out of 30). More transcripts might have revealed a wider variation in the variables. Also, patients with MMSE scores in the mild and more severe range could reveal a wider range of outcomes, and might show more differences between CLAN and SALT analyses.

Future Studies

There are a few changes that would make a difference in the data if it were to be reanalyzed with the same variables. First, the analysis set in SALT should be compared against CLAN's results instead of total utterances section in SALT. By adjusting the analysis set output to exclude unintelligible utterances (xxx) and all utterances that contain specific codes (&=laughs, *cu, etc), the results could potentially become closer because unintelligible utterances would be excluded creating fewer types of words and a lower TTR for SALT. However, it is also possible to include unintelligible utterances in CLAN by leaving out the [+ exc] in the input window. Then, data could be compared based on unintelligible utterances included in the patient's answer. Now that it's understood how to exclude or include certain parts of the participant's speech, comparing more of the variables CLAN and SALT use becomes more efficient. The results of comparing different variables could either show more consistent results between programs or there could potentially be more differences. Overall, both programs showed similar outcomes in terms of utterances, morphemes, and MLU. The CLAN program is beginning to be used to study the language deterioration with patients who have dementia whereas SALT is still more geared towards children's speech. More of this work should be done with different stages of dementia because knowing how language changes in dementia is what is important to help clinicians develop good treatment programs to help people communicate better.

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